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ABSTRACT

This curriculum guide was developed to provide environmental education through a series of hands-on activities for the classroom and the outdoor setting of Goose Creek State Park, North Carolina. This activity packet, designed for the 4th, 5th, and 6th grades, meets established curriculum objectives of the North Carolina Department of Public Instruction's Standard Course of Study. Students are exposed to the following major concepts: wetland physiology, wetland hydrology, wetland soils, wetland habitats, water quality, wetland flora and fauna, resource management, and adaptations. The packet is divided into eight section: (1) introduction to the North Carolina State Parks System, Goose Creek State Park, Wetlands, and the activity packet; (2) activity summary; (3) pre-visit activities; (4) on-site activities; (5) post-visit activities; (6) vocabulary and definitions; (7) references (26 entries); and (8) a scheduling worksheet, parental permission form, and program evaluation. Activity information includes curriculum objectives for each grade level, location, group size, estimated time, appropriate season, materials, major concepts, objectives, educator's information, student's information, and worksheets. (LZ)

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WETLAND WONDERS

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Goose Creek State Park

An Environmental Education Learning Experience

Designed for Grades 4-6

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WETLAND WONDERS

Goose Creek State Park

An Environmental Education Learning Experience

Designed for Grades 4-6

"When I would recreate myself,
I seek the darkest wood, the thickest and
most interminable and dismal swamp.
I enter the swamp as a sacred place –
a sanctum sanctorum. There is the
strength, the marrow of Nature."

- Henry David Thoreau,
natural history essay, 1862

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CP&L

This Environmental Education Learning Experience
was developed by
the staff at
Goose Creek State Park

N.C. Division of Parks and Recreation
Department of Environment, Health and Natural Resources

James B. Hunt, Jr.
Governor

Jonathan B. Howes
Secretary

Other Contributors . . .

Park volunteers;

Albemarle-Pamlico Estuarine Study;

Beth Bateman, Science/Math Educator,
Bath Elementary School;

Goose Creek Education and Research Foundation;

Louise Hinsley, Beaufort County Cooperative
Extension Agent, Beaufort County, N.C.;

Mary Walter Rumley, Education Specialist,
Albemarle-Pamlico Estuarine Study programs;

Pamlico-Tar River Foundation, Inc.;

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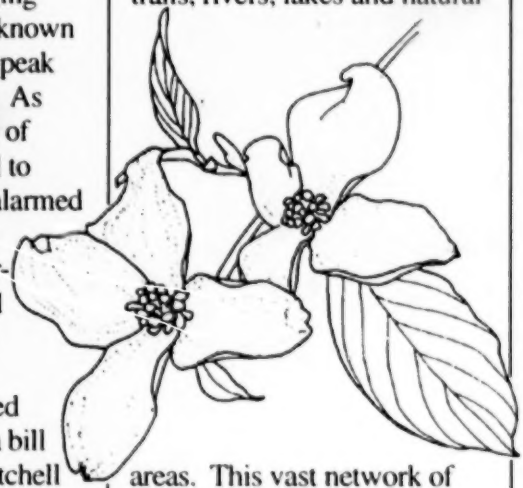
Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park of North Carolina. That was in 1915.

The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.



As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 125,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the Earth.

For more information contact:

N.C. Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-4181

Introduction to Goose Creek State Park

Efforts to establish a state park on the Pamlico River began in 1969. At the request of local citizens, the Division of State Parks surveyed the area along the Pamlico River for potential sites. The area around Goose Creek was determined to be the most suitable location. With support from local citizens, Goose Creek State Park became a reality on September 25, 1974 with the acquisition of almost 1,209 acres. Today the park contains 1,597 acres.

Though documented historical information for the park site is sparse, it is known that a Tuscarora village was located between Goose Creek and the town of Bath. Captain Thomas Blount, exploring the Pamlico region on May 21, 1701, landed near Ragged Point on the present park site. John Lawson, the famous explorer and Surveyor-General of North Carolina, may have owned, in the early 1700's, some of the land that is now included in the park. Evidence of more recent use can be found along the river shore in the form of old homesites and pier remains.

Goose Creek Flora and Fauna:

Goose Creek State Park provides important habitat for a vast array of coastal plain plants and animals. Within its boundaries, Goose Creek contains several distinct plant communities, including mature loblolly pine forest, hardwood forest, swamp forest and tidal freshwater marsh. It also includes areas that were clearcut before the park was created. These areas are in various stages of forest succession. Five hiking trails and two boardwalks provide access to these various habitats.

These different plant communities located next to a major coastal plain river provide food and habitat for a diverse group of animals. Many species of birds live in the park, the most significant being the red-cockaded woodpecker, the bald eagle and the osprey. The endangered red-cockaded woodpecker occurs in the mature pine forest, while the osprey nests in dead snags and may be seen fishing along the river. Bald eagles, also endangered, are not common, but may be seen throughout the year.

The Pamlico River and nearby Pamlico Sound provide an important wintering

area for several species of waterfowl. Mammals such as deer, fox, otter, mink, raccoon and bobcat are present, though seldom seen. Saltwater and freshwater fish may be found at Goose Creek. The economically important blue crab ranges from the Pamlico Sound to tidal freshwater marshes like Goose Creek. Largemouth bass, bluegill, white perch and yellow perch are commonly caught. Reptiles, amphibians, and insects abound throughout the park. Keep an eye out for alligators–they have been sighted outside the park!

Scheduling a Trip:

1. Please contact the park at least two weeks in advance to make a reservation.

2. Complete the Scheduling Worksheet located on page 8.1, and return it to the park as soon as possible.

3. Research activity permits may be required for sampling activities. If your group plans to collect any plant, animal or mineral within the park, please contact the park office at least 30 days in advance to obtain a permit application.

Before the Trip:

1. Complete the pre-visit activity in the Environmental Education Learning Experience.

2. The group leader should visit the park without the participants prior to the group trip. This will enable you to become familiar with the facilities and park staff, and to identify any potential problems.

3. The group leaders should discuss park rules and behavior expectations with adult leaders and participants. Safety should be stressed.

4. Everyone should wear a name tag. Please color-code tags (for groups) and establish a buddy system.

5. Activities that take place outdoors may expose participants to insects and seasonal weather conditions. Poison ivy is abundant in certain areas in the park and should be avoided. Be prepared by dressing accordingly and wearing sunscreen or insect repellent, if necessary.

6. Comfortable walking shoes should be worn. Students need to bring shoes that they do not mind getting wet or dirty, an extra change of clothes and a towel. Some activities may be in the wetland!

7. *The group leader is responsible for obtaining a parental permission form from each participant, including a list of any health considerations and medical needs.* An example of this form is on page 8.2.

8. *If you will be late or need to cancel your trip, please notify the park as far ahead as possible.*

Belted Kingfisher

While At the Park:

Please obey the following rules:

1. To help you get the most out of the experience and increase the chance of observing wildlife, be as quiet as possible while in the park.

2. On hikes, walk behind the leader at all times. Stay on marked trails and boardwalks. Running is not permitted.

3. All plants and animals within the park are protected. Breaking plants and harming animals are prohibited in all state parks. This allows future visitors the same opportunity to enjoy our natural resources.

4. Picnic in designated picnic areas only. Please help keep the park clean by not littering. Restrooms and drinking water are available in the picnic area.

5. Swimming is permitted in the Pamlico River in the designated swimming area, however, there are no lifeguards available. It is suggested that you provide your own lifeguards if your group would like to swim.

6. In case of accident or emergency, contact park staff immediately.

Following the Trip:

1. Complete the post-visit activity in the Environmental Education Learning Experience packet.

2. Build upon the field experience and encourage participants to seek answers to questions and problems encountered at the park.

3. Relate the experience to classroom activities and curriculum through reports, projects, demonstrations, displays and presentations.

4. Give tests or evaluations, if appropriate, to determine if students have gained the desired information from the experience.

5. File a written evaluation of the experience with the park. Evaluation forms are available in the activity packet on page 8.3.

Park Information:

Goose Creek State Park
Route 2, Box 372
Washington, NC 27889
Fax# 919-923-0052
Telephone 919-923-2191

Office Hours:

Year round 8:00 am - 4:30 pm
Monday - Friday

Hours Of Operation:

Nov - Feb	8:00 am - 6:00 pm
Mar - Oct	8:00 am - 7:00 pm
Apr,May,Sep	8:00 am - 8:00 pm
Jun - Aug	8:00 am - 9:00 pm

Introduction to the Activity Packet for Goose Creek State Park

The Environmental Education Learning Experience, *Wetland Wonders,* was developed to provide environmental education through a series of hands-on activities for the classroom and the outdoor setting of Goose Creek State Park. This activity packet, designed for the 4th, 5th and 6th grades, meets established curriculum objectives of the North Carolina Department of Public Instruction's Standard Course of Study. Three types of activities are included:

1) pre-visit activity
2) on-site activity
3) post-visit activity

The on-site activity will be conducted at the park, while pre-visit and post-visit activities are designed for the classroom. Pre-visit activities should be introduced prior to the park visit so that students will have the necessary background and vocabulary for the on-site activities. We encourage you to use the post-visit activities to reinforce concepts, skills and vocabulary learned in the pre-visit and on-site activities. These activities may be performed independently, however they have been designed to be done in a series to build upon the students' newly gained knowledge and experiences.

The Environmental Education Learning Experience, *Wetland Wonders,* will expose the student to the following major concepts:

- **Wetland physiology**
- **Wetland hydrology**
- **Wetland soils**
- **Wetland habitats**
- **Water quality**
- **Wetland flora & fauna**
- **Resource management**
- **Adaptations**

The first occurrence of vocabulary words used in these activities is indicated in **bold type**. Their definitions are listed in the back of the activity packet. A list of the reference materials used in developing the activities follows the vocabulary list.

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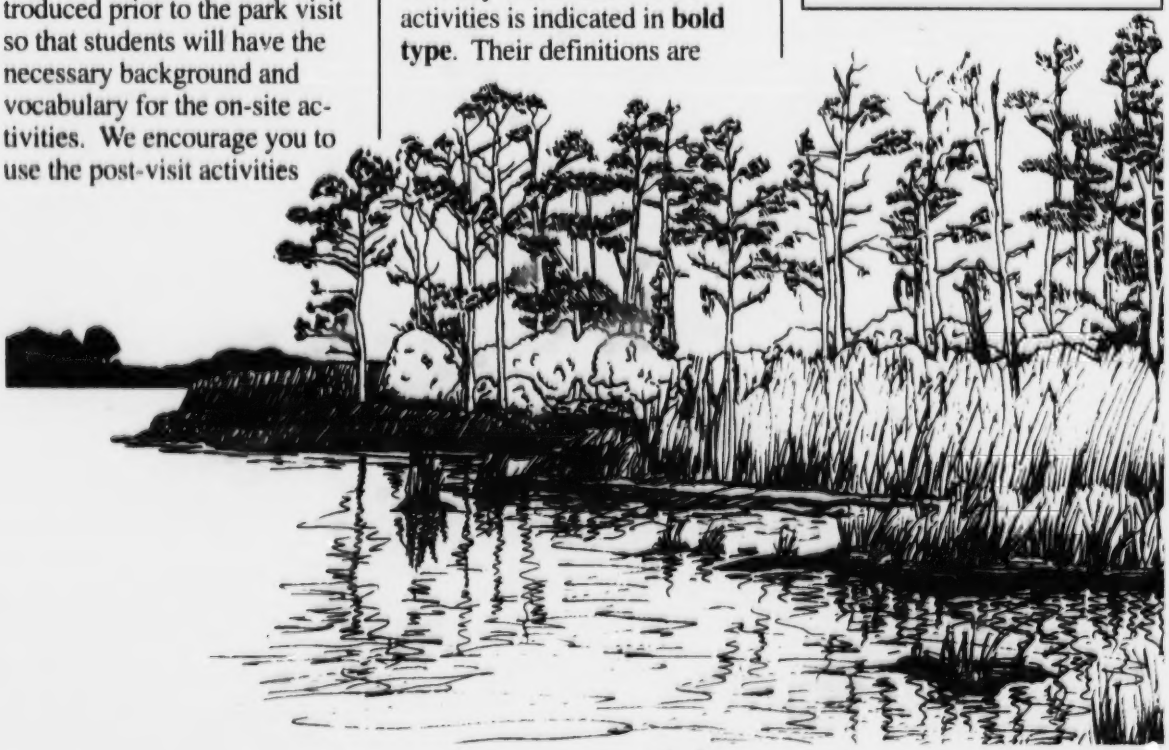
Note:
The on-site activity will require hiking which could expose the students to hot or cold conditions and ticks and other insects. Accessibility to some of these areas may be difficult for persons with special needs. When conducting the on-site activity, please remember that collecting specimens of any kind in the park is prohibited.



Introduction to Wetlands

"A horrible desert, the foul damps ascend without ceasing, corrupt the air and render it unfit for respiration... Never was Rum, that cordial of Life, found more necessary than in this Dirty Place."

So said Colonel William Byrd in the 17th century while surveying the Great Dismal Swamp on the Virginia-North Carolina Border. In fact, Colonel Byrd is credited for naming the swamp.

This sinister and forbidden image of **wetlands** has endured through present times. Ask a person to describe a wetland and you may hear about mosquitoes, snakes, muck and foul air. Since Colonel Byrd's time, people have viewed wetlands as wastelands, space that could be used for farms, shopping malls, highways and landfills. Our nations wetlands have been ditched, drained, and filled. Since colonial times, approximately 50% of the United States' 215 million acres of wetlands have been destroyed. Today, wetlands are the center of controversy because some people believe wetlands are an invaluable resource. While others feel wetlands should be developed for farming, housing, and other uses to boost the economy. You may see bumper stickers on cars saying "Save Our Wetlands" or "No Wetlands, No Seafood." What has caused people to change their minds about wetlands? Let's take a closer look to see if we can better understand what wetlands are, and why they are important.

What Makes a Wetland a Wetland

In 1977, the US Army Corps of Engineers and the Environmental Protection Agency, (two federal agencies charged with regulating activities in wetlands), published this definition of a wetland:

"those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Wetlands are often transition zones that lie between dry land and waterways, but some are isolated. The most common types are swamps, **pocosins** and marshes. Other types include: bogs, bottomlands, **fens**, mires, moors, Carolina bays, muskegs, **peat** land, playa lakes, potholes, sloughs and wet meadows. At Goose Creek State Park you can observe four types of wet-

lands: nonriverine swamp forest, coastal plain small stream swamp forest, tidal cypress-gum swamp forest and a tidal freshwater marsh. However, all wetlands have three common denominators: **water**, special soil and specialized plants. The arrangement of these three characteristics differentiates one wetland from another.

Water

Water binds all of the components needed to produce wetlands. It is the main ingredient and dictates soil structure and the **species** of plants and animals that characterize a wetland. Water in a wetland may be fresh, **brackish** (slightly salty) or salty. Water may be tidal or nontidal.

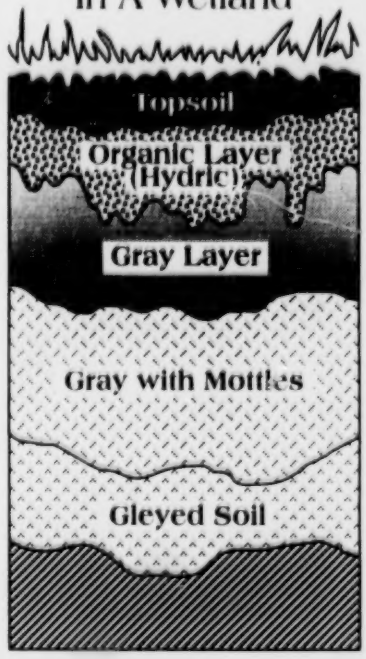
The water in wetlands comes from two sources: surface water and ground water. Surface water is **precipitation** or water from streams, rivers, lakes or oceans. Ground water is water beneath the Earth's surface. One attribute shared by all wetlands is constant or periodic flooding or inundation and soil saturation. In other words, a wetland can always be wet, wet at certain seasons, and dry at others, or regularly or irregularly flooded. One definition of a wetland is that it must be wet for 7-30 consecutive days or more and have soil that is saturated within 6-18 inches of the surface, during the growing season.

The pH of the water also affects what lives in a wetland. pH refers to how acidic or alkaline a substance is. Scientist use a pH scale to determine or define how acidic or alkaline something is. This scale goes from 0 to 14. A pH of 0 is extremely acidic while a pH of 14 would be very alkaline. For example, lemon juice, vinegar, and the fluid in a car battery are all acidic liquids. They would have a very low pH, (probably between 0 and 5). Liquids like milk and dish detergent are examples of alkaline substances and would have a higher pH, (probably between 7 and 10). Wetland plants and animals have adapted to live within specific pH ranges.

Soil

With a prolonged presence of water, the soil develops special conditions and is called **hydric** soil. In water-saturated soil, most or all of the pore spaces are filled with water leaving little or no room for oxygen. Thus the soil becomes **anaerobic**, (lacking oxygen). Because of the saturation and anaerobic nature of hydric soil, many chemical reactions occur which cause physical changes in the soil. The initial composition of the soil, the wetness and/or the frequency and length of flooding will determine the soils appearance and texture. Since the soil lacks oxygen, **organisms** living in the soil must carry out anaerobic respiration. **Bacteria**, which break down **organic** material, will use sulfur compounds to help perform their metabolic processes. A by-product of these metabolic processes is hydrogen sulfide gas which gives hydric soil the rotten egg odor, characteristic of a marsh.

Sample Soil Layers In A Wetland



Plants

Plants found in wetlands are referred to as **hydrophytic** (water loving) plants. Plant communities help define wetland areas. Wetland plants have adapted to a very stressful **environment**. Some plants have to survive flooding and drought, silting, saltwater intrusion and chemicals that may wash off the adjacent lands. Floating plants must be light enough to float yet strong enough to hold their shape. **Aquatic** plants may use special water-filled channels in

their leaves and stems for support. Other plants that have roots under water and leaves above water (called emergent plants) must be able to support themselves. In addition, plants growing in salty areas have developed specialized cells that control salt content by excreting salt from the plant's body.

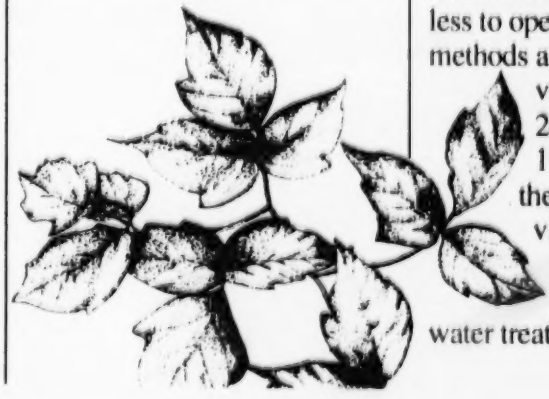
Plants take carbon dioxide out of the air and release oxygen. Plants also need to absorb oxygen through their roots, but in wetland soils there is little, if any, oxygen available. Therefore, wetland plants have adapted special air spaces —**aerenchyma**—for transporting oxygen from leaf to root. Trees growing in wetlands also have special **adaptations** to help deal with t his environment. Knees, or **pnematophores**, are a secondary root system that rise above the surface of the water enabling trees like the cypress to survive. Tree trunks that have swollen bases—**buttresses**—help aerate the tree. Some trees have shallow roots that grow from the stem tissue just under the soil surface allowing the tree to obtain oxygen and exchange gases.

These are the ingredients needed to create a wetland. When all of these ingredients come together we have one of the richest, most productive and important **ecosystems** on Earth.

Wild Wonderful Wetland Facts

• Wetlands provide important **habitat** for plants, fish and wildlife. One third of America's **threatened** and **endangered species** live in wetlands.

• Wetlands are one of the most productive habitats on Earth. In the southeast, 96% of the commercial and 50% of the recreational fish and shellfish depend on wetlands for all or part of their life cycles.



• In 1981, the Louisiana shrimp and menhaden catch was valued at 200 million dollars. Marshes and wetlands are critical for these two species.

• 55 million people spent almost 10 BILLION DOLLARS in 1980 observing and photographing waterfowl and other wetland dependent species.

• Wetlands can help store and recharge groundwater supplies. A 2,700-acre wetland in Massachusetts was found to add 8 million gallons of water a day to a shallow **aquifer**. This aquifer provides drinking water for a nearby city.

• Some wetlands can slow and retain large amounts of water during flood events, thus reducing damage from floods.

• Wetlands and wetland plants have been found to trap **sediment** and other **pollutants** that are washed off the land.

• Recently, scientists have begun experimenting with wetland plants and using them to treat wastewater. In Arcata, California they created a 96 acre wetland to treat their wastewater. This system costs less to operate then traditional methods and the wetland provides habitat for over 200 species of birds. 100,000 people use the trails, wildlife viewing blinds and picnic facilities at this natural wastewater treatment area each year.

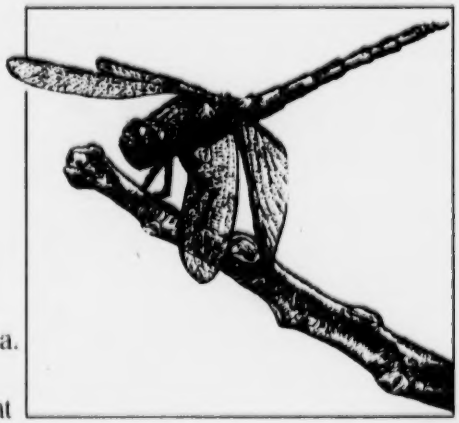
Activity Summary

The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

I. Pre-Visit Activity

#1 North Carolina's Wild Wetlands (page 3.1.1)

Using a set of clue cards and a simple key, students will be introduced to the diversity, location and basic classification of wetlands in North Carolina. They will use the clues and key to identify different wetlands.



Major concepts:

- Location of wetlands in North Carolina
- Different types of wetlands in North Carolina
- Wetland classification
- Use of a simple key

Objectives:

- Describe the three components needed to have a wetland.
- Name five types of wetlands found in North Carolina.
- Using a North Carolina state transportation map, locate the five counties mentioned in this activity that contain wetlands.

II. On-Site Activity

#1 Wetland Water (page 4.1.1)

Students will determine the quality of the water found in a freshwater tidal marsh and the Pamlico River by performing three hands-on water quality tests (pH, salinity, dissolved oxygen). They will also test a sample of tap water from school for pH and salinity.

Major Concepts:

- Water quality
- Wetland functions
- Watersheds
- Human impact on wetlands
- Water testing

Objectives:

- Demonstrate the use of three LaMotte test kits to determine pH, dissolved oxygen and salinity.
- Analyze samples and compare results between wetland samples and the Pamlico River.
- List three human influences which can affect the water quality at Goose Creek.
- Name the river/watershed of which Goose Creek State Park is a part.

III. Post-Visit Activity

#1 Goose Creek (page 5.1.1)

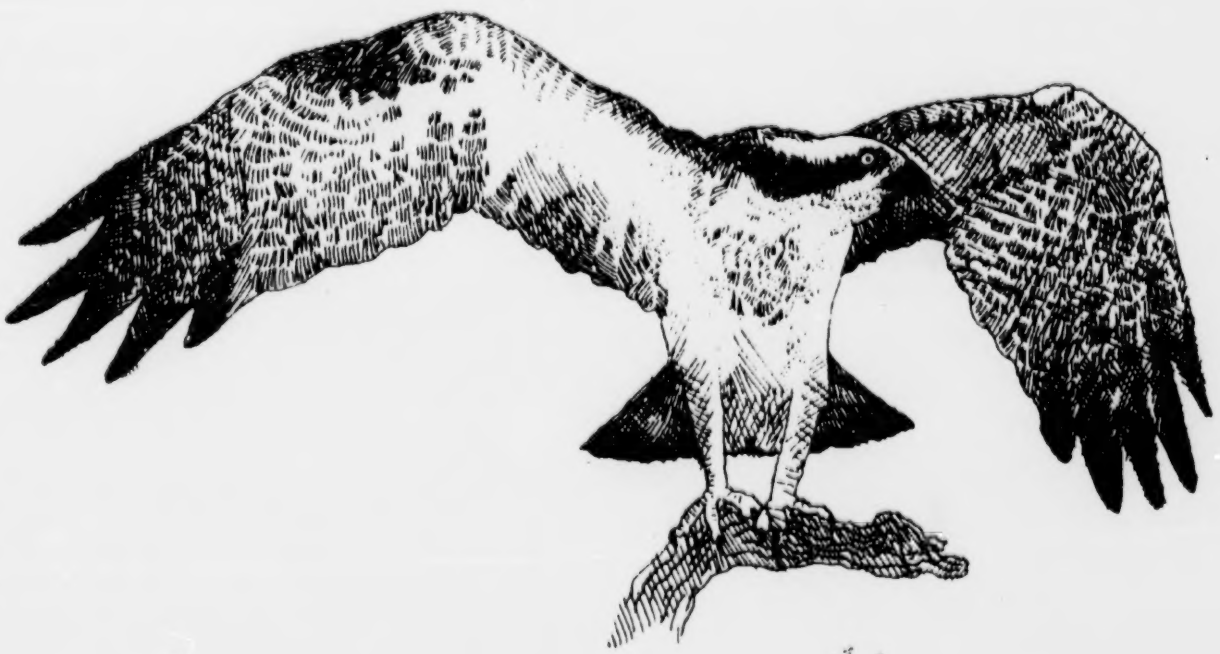
Using a topographic map of the Goose Creek area and land use cutouts, students will make decisions about development of land surrounding Goose Creek State Park.

Major concepts:

- Human impact on Goose Creek wetlands and the Pamlico River
- Water quality
- Land use planning and its effect on Goose Creek and areas downriver
- Resource management

Objectives:

- Evaluate the effects of different imaginary land uses on Goose Creek and the Pamlico River.
- Discuss and list five ways to minimize damaging effects on Goose Creek and the Pamlico River.



Pre-Visit Activity #1 North Carolina's Wild Wetlands

Curriculum Objectives:
Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: group interaction
- Science: living things-animals, adaptation to environment, interdependence of animals
- Social Studies: gather organize and analyze information, draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension, study skills
- Science: Earth science, environment

Grade 6
- Communication skills: listening and visual comprehension, study skills
- Science: Earth science, environment

Location: Classroom

Group Size:
30 students, class size

Estimated Time:
One class period

Appropriate Season: Any

Materials:
Provided by educator:
Per student or group: One copy of the "North Carolina's Wetlands - Habitat Clue Cards," one copy of "A Key to North Carolina's Wetland Habitats" Several North Carolina Department of Transportation road maps

Major Concepts:
- Location of wetlands in North Carolina
- Different types of wetlands in North Carolina
- Wetland classification
- Use of a simple key

Objectives:
- Describe the three components needed to have a wetland.
- Name five types of wetlands found in North Carolina.
- Using a North Carolina state transportation map, locate the five counties mentioned in this activity that contain wetlands.

Educator's Information:

The purpose of this activity is to expose the student to the variety of **wetland habitats** found in North Carolina and their locations. The students will also use a simple **key** to identify or classify wetland habitats found in North Carolina.

Classifying wetlands has been and is still a controversial and confusing issue. One reason is that detailed studies of wetlands show that there are many different types. Distinct differences in plant **species**, soils, **water** chemistry, as well as geographic location and climate combine to create one of the most complex **ecosystems** on Earth. However, the US Fish & Wildlife Service has put out a technical publication, *Classification of Wetlands and Deepwater Habitats of the United States* (listed in the reference section), that is widely used and has helped standardize the **classification** of wetland habitats.

Keys:

A key is an essential tool used by people to help identify or classify plants, animals or in this case, habitats. A key is an ordered list of significant characteristics that describes an **organism** or again, in our case, wetland habitats. Keys often use a combination of pictures and written descriptions to aid in identification or classification.

How a Key Works:

A list of characteristics is arranged as a series of either / or statements. For each pair of statements, choose the one that best describes the item you're identifying. For example, if you were handed a pine needle to identify, you would start at the top of the key with these two choices:

1. Leaves long and needle-like.

2. Leaves not long and needle-like.

Of course, a pine needle is long and needle-like so you would choose that statement and continue to the next choice under that side of the **dichotomous** key.

Instructions:

Have students read the "Introduction to Wetlands" and the Student's Information. Hand out copies of the "North Carolina's Wetlands - Habitat Clue Cards." Hand out copies of "A Key to North Carolina's Wetland Habitats." Discuss what a dichotomous key is and how to use it. Have the students cut the Wetlands - Habitat Clue Cards along the dotted lines. The students should pick a card and read it. They should then start at the top of "A Key to North Carolina's Wetland Habitats" and key out the wetland habitat described on the Clue Card. They should do this for all nine cards. When everyone is done, hand out copies of North Carolina's road map. Have each student locate the five counties mentioned in the activity.

Wetland - Habitat Clue Cards Answers

A. Southern Appalachian Fen

D. Southern Appalachian Bog

G. Pocosin

B. Salt Marsh

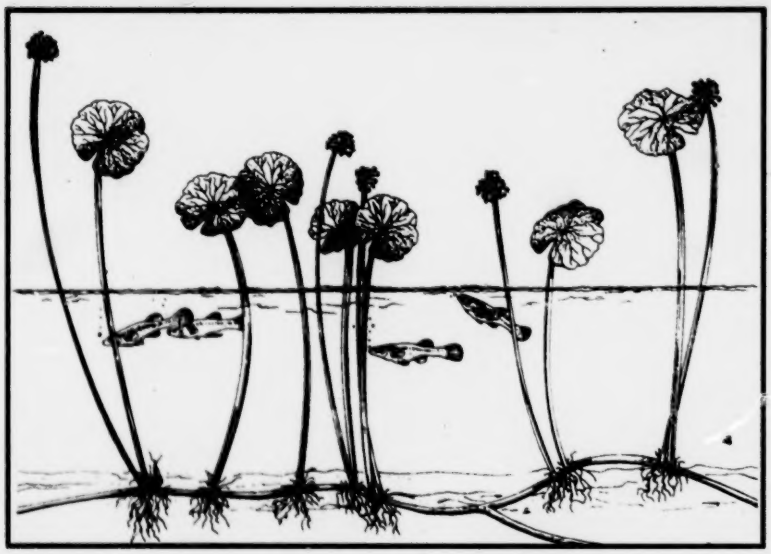
E. Tidal Freshwater Marsh

H. Piedmont/Mountain/Levee Forest

C. Tidal Cypress-Gum Swamp

F. Aquatic Bed

I. Eel Grass Bed



Did you know that there are 46 different **habitats** or **communities** in North Carolina that might meet the definition of a **wetland**? Wetland ecologists no longer refer to wetlands as merely a swamp or marsh. Instead, you will now hear terms like "coastal plain levee forest - **blackwater** subtype," "nonriverine hardwood forest," or "southern Appalachian bog - northern subtype." Sounds complicated, doesn't it? Why not stick to swamp, marsh and bog? We all know these terms. After all, we know that all wetlands have three main components; **water**, special soil, and **hydrophytic** (water-loving) plants. Let's take a closer look at wetland **classification** and see if we can make some sense of it.

Wetland Classification:

As wetland ecologists learn more about the complex interrelationships between wetlands, their geographic location and climate, they have found that there are lots of different types of wetlands. They classify or name wetlands using a specific description. For example, "southern Appalachian bog - northern subtype," gives us the location and general type of wetland, and tells us that the bog has characteristics of a northern bog. This classification system is necessary because it ensures that wetland ecologists in North Carolina all use the same names when referring to a particular wetland.

When you visit Goose Creek State Park, you will be working in a tidal freshwater marsh. Other wetland types found at Goose Creek are coastal plain small stream swamp forest, nonriverine swamp forest, and a tidal cypress-gum swamp. So you see there is more to a wetland than meets the eye. The following activity will give you an idea of several wetland types found in North Carolina and their locations.

Goose Creek Wetlands

Tidal Freshwater Marsh:

Found along the margins of estuaries, rivers, or creeks that are regularly or irregularly flooded with freshwater **tides**. **Salinity** (the amount of salt in the water) is usually five parts salt per thousand parts water or lower, but may be higher during rare high tide events (seawater is 35 ppt, parts per thousand). Plant diversity is high in this type of wetland. A few dominant plants found in this wetland are cattails, sawgrass, salt grass, black needlerush, sedges, pennywort and bulrush. Shrubs and trees include wax myrtle, red cedar, bald cypress and groundsel tree.

wax myrtle

Coastal Plain Small Stream Swamp Forest -

(Blackwater subtype):

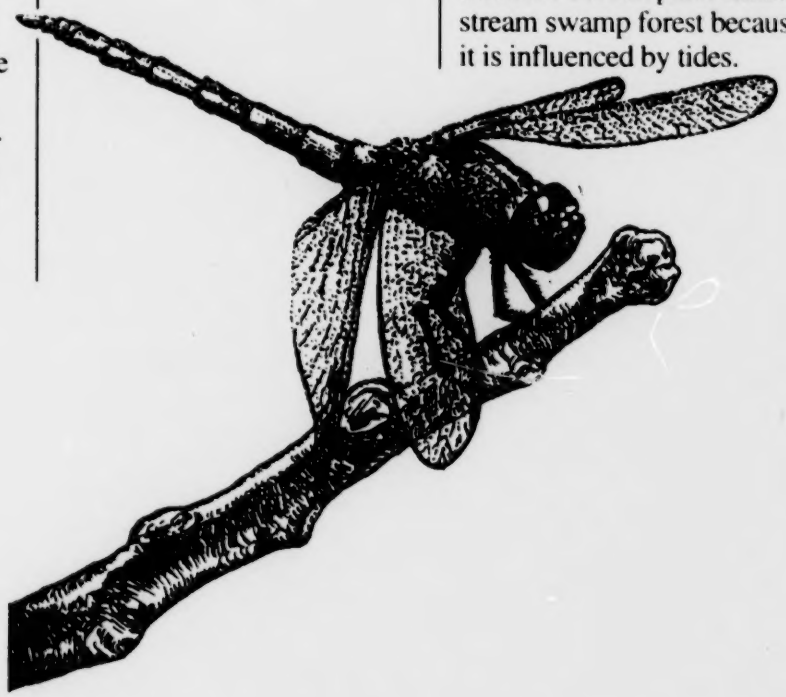
Found along small blackwater streams that have a poorly developed floodplain. The water is **acidic** and water flow is variable. Trees typical of this area include bald cypress, swamp tupelo, red maple and river birch. This wetland forest occurs near the upper end of small streams above normal tide influences. Down stream where there is a tidal influence this wetland forest grades into the tidal cypress-gum swamp forest.

Nonriverine Swamp Forest:

Found on poorly drained upland flats, well away from streams. This area is distinguished by its location and the dominance of swamp trees like cypress and swamp tupelo.

Tidal Cypress-Gum Swamp:

Found along the margins of creeks, normally behind where the tidal freshwater marsh is predominant. Bald cypress, swamp tupelo, red maple and other water loving hardwoods are dominant. This area differs from the coastal plain small stream swamp forest because it is influenced by tides.



North Carolina's Wetlands - Habitat Clue Cards

A. North Carolina's only example of this rare type of wetland occurs on Bluff Mountain in *Ashe* County. Wet, mucky soil covering shallow bedrock creates perfect conditions for this type of wetland. Water is found most of the year due to seepage of mineral rich alkaline (high pH) water. Grasses, wildflowers, ferns and small shrubs dominate. Because of the mineral-rich, alkaline water, many of the plants found here are unusual to North Carolina.

B. 95% of all commercial seafood species depend on these food-rich wetlands during some stage of their life. The land is alternately covered and uncovered with water. Water is tidal and very salty. Tall grasses stick above the water. A good example of this wetland can be found at Hammocks Beach State Park in *Onslow* County.

C. Major coastal plain rivers have this wetland habitat. They are seasonally to semi-permanently flooded. The water is usually neutral (not acidic or alkaline). The presence of gum and cypress trees is a good clue. The Roanoke River has extensive wetlands of this type.

D. This type of wetland is found in scattered locations throughout the mountains of North Carolina. It occurs on relatively flat, poorly drained areas that are permanently wet to intermittently dry. The soil is organic and is very acidic (low pH). Sphagnum moss, ferns, wildflowers, herbs and shrubs dominate. Trees may be widely scattered around this wetland or grouped along the edges. Panthertown Valley in *Jackson* County has examples of this wetland.

E. This type of marsh occurs where small creeks and rivers flow into large coastal rivers. These wetlands are flooded regularly or irregularly by lunar or wind tides. The water is usually fresh to slightly salty. Grasses and dense herbaceous (low growing) plants, along with widely scattered trees and shrubs make up the plant community. Goose Creek State Park in *Beaufort* County has a good example of this wetland.

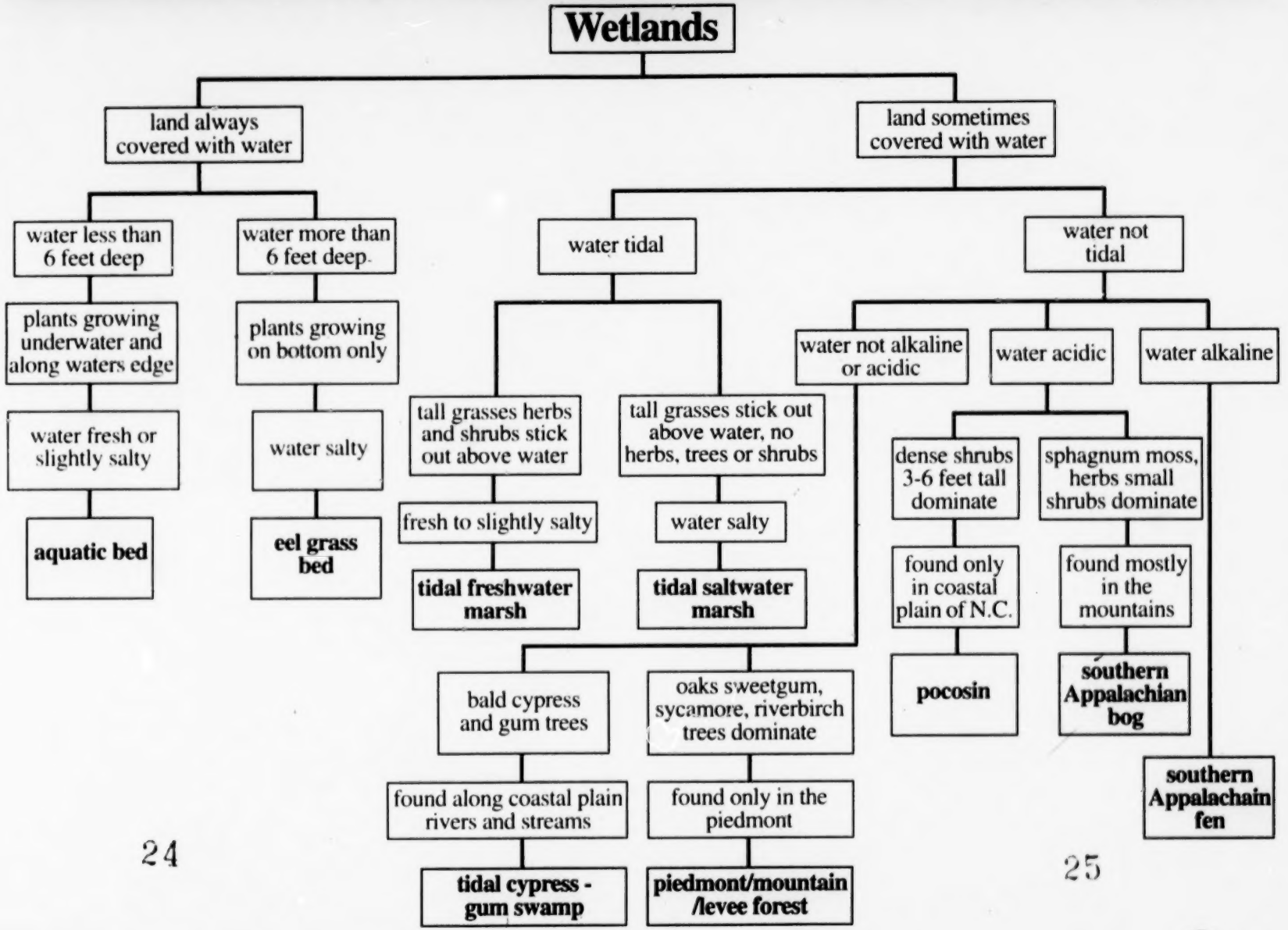
F. Water is always present, is usually fresh and less than six feet deep. Plants may be found growing underwater, growing from the sediment and floating on the surface, or growing from the water's edge. Look for this wetland type along the edges of ponds, lakes, rivers and streams. This wetland may eventually turn into a marsh.

G. North Carolina has the largest remaining tracts of this wetland. These wetlands are seasonally flooded or saturated. Soil and water are acidic. Dense shrubs, between three feet and six feet tall, dominate this type of wetland. These wetlands are confined to the coastal plain. Native Americans called this wetland "swamp on a hill." A National Wildlife Refuge located in eastern North Carolina is named after this wetland type.

H. The presence of large oak, sweetgum and poplar trees, and the absence of shrubs and herbs are good indications of this type of wetland. These wetlands are seasonally to frequently flooded. The water is usually neutral (neither acidic or alkaline). These wetlands can be found on New Hope Creek at the upper end of Jordan Lake in *Durham* County.

I. Water is always present in this wetland type. The water is usually salty and can be deeper than six feet. Plants grow underwater on the bottom. This area is extremely important to many different aquatic species. Remnants of this habitat can be found in the Pamlico Sound. Some scientists do not consider this a wetland.

A Key to North Carolina's Wetland Habitats


Wetlands
land always covered with water
land sometimes covered with water
water less than 6 feet deep
water more than 6 feet deep
water tidal
water not tidal
plants growing underwater and along waters edge
plants growing on bottom only
water not alkaline or acidic
water acidic
water alkaline
water fresh or slightly salty
water salty
tall grasses herbs and shrubs stick out above water
tall grasses stick out above water, no herbs, trees or shrubs
dense shrubs 3-6 feet tall dominate
sphagnum moss, herbs small shrubs dominate
aquatic bed
eel grass bed
fresh to slightly salty
water salty
found only in coastal plain of N.C.
found mostly in the mountains
tidal freshwater marsh
tidal saltwater marsh
pocosin
southern Appalachian bog
bald cypress and gum trees
oaks sweetgum, sycamore, riverbirch trees dominate
southern Appalachain fen
found along coastal plain rivers and streams
found only in the piedmont
tidal cypress - gum swamp
piedmont/mountain /levee forest

24

25

On-Site Activity #1 — Wetland Water

Curriculum Objectives:

Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: group interaction
- Healthful Living: recreation safety
- Mathematics: measurement
- Science: living things-animals, adaptation to environment, interdependence of animals
- Social Studies: gather, organize and analyze information; draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension, study skills
- Healthful Living: school safety
- Math: measurement *Science: Earth science, environment
- Social Science : organize analyze information, draw conclusions

Grade 6
- Communications Skills: listening and visual comprehension, study skills
- Healthful Living: environmental health, home safety
- Math: measurement
- Science: ecology
- Social Science: organize, analyze information, draw conclusions

Location:
Ragged Point Trail

Group Size:
Maximum of 30 students

Estimated Time:
1 to 1 1/2 hours

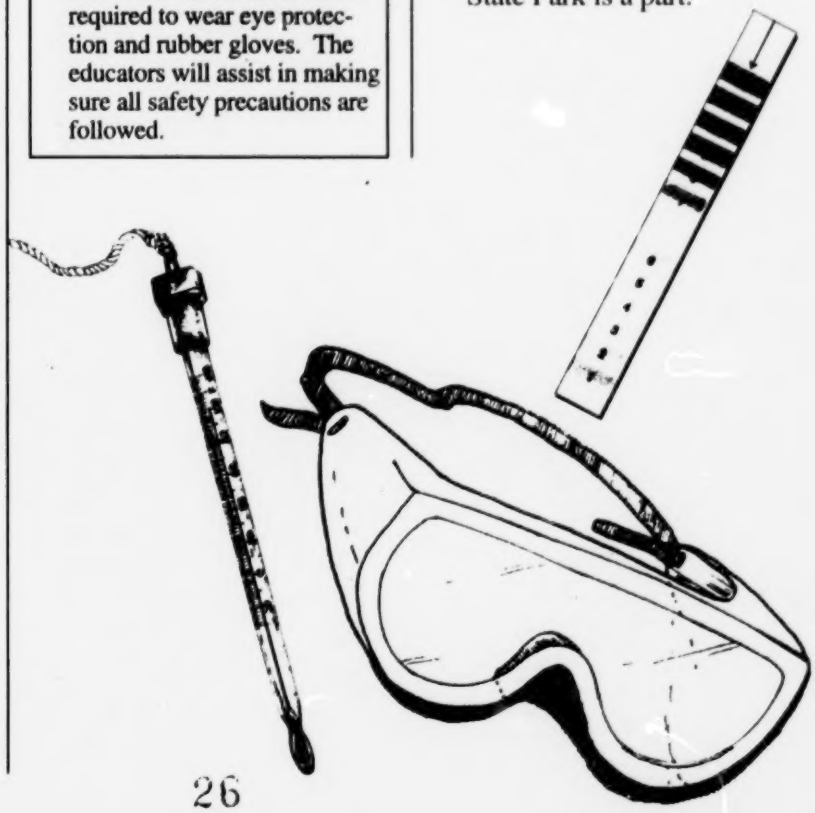
Appropriate Season: Any

Materials:
Provided by educator:
Per group: one copy of data sheet
Provided by park: 9 LaMotte test kits, rubber gloves, eye protection, three thermometers, easel or large writing pad

Special Considerations:
Each class needs to have at least four adults to help with each group. Mosquitoes, ticks, and hot humid weather may be encountered in the summer months. Chemical reagents are used in water quality testing. Because misuse of these chemicals can be hazardous, standard chemical protection procedures will be required. While performing these tests the students will be required to wear eye protection and rubber gloves. The educators will assist in making sure all safety precautions are followed.

Major Concepts:
- Water quality
- Wetland functions
- Watersheds
- Human impact on wetlands
- Water testing

Objectives:
- Demonstrate the use of three LaMotte test kits to determine pH, dissolved oxygen and salinity.
- Analyze samples and compare results between wetland samples and the Pamlico River.
- List three human influences which can affect the water quality at Goose Creek.
- Name the river/watershed of which Goose Creek State Park is a part.



Educator's Information:

The students will be involved in collecting **water** samples and performing several tests to determine the quality of the water of Goose Creek's **wetlands** and the Pamlico River. Park staff will lead a discussion on basic wetland function, **watersheds**, water quality, and natural and human influences which can affect Goose Creeks' wetlands and the plants and animals that live there. Students will use LaMotte test kits to determine **pH**, **dissolved oxygen** (DO) and **salinity**.

Divide the students into three groups. They will be responsible for collecting the samples, performing the tests and recording the results on their data sheets. After each group has finished, gather and discuss their results. Prior to your visit, have the students read the Student's Information and the Introduction to Wetlands and complete the Pre-Visit Activity. Review the Student's Information on pH, DO and salinity.

* Have students select two liquids that they would like to test for pH and bring them with you; one should be **alkaline** and the other, **acid**. Also, bring a quart of tap water from your school to test its pH and salinity.

** Park staff will collect the students' data sheets and enter their results into a computer to develop baseline data for monitoring the quality of the water at Goose Creek State Park. Please emphasize the importance of their contributions in monitoring water quality in the park.

Instructions:

1. Park staff will lead a brief discussion focusing on the type of wetland the students will be working in, basic wetland function, the importance of wetlands, factors that are affecting Goose Creek's wetlands and the importance of water quality monitoring.

2. Park staff or the educator will test the water samples and the two liquid samples the students brought from school. Test the tap water for pH and salinity and test the two liquid samples for pH. Do this to demonstrate the use of the LaMotte test kits. Record the results on an easel.

3. Separate the students into three groups. One adult or park staff member should accompany each group. Each group will collect water from one of the following sites:

Site I - beginning of boardwalk;

Site II - middle to end of boardwalk;

Site III - swimming beach

4. Within each group, form the students into three teams; one group will test pH, one will test dissolved oxygen (DO), and one will test salinity. Each group will check the water temperature. Each team member should have a task; for example, one person reads the test instructions, one person performs the test, one records the results, and one gets the water sample and takes the water temperature.

5. Distribute the containers and test kits for collecting the samples.

6. Discuss the proper way to collect the samples. Stress that the person performing the test will be required to wear rubber gloves and eye protection. Advise them to follow the LaMotte test kit instructions carefully.

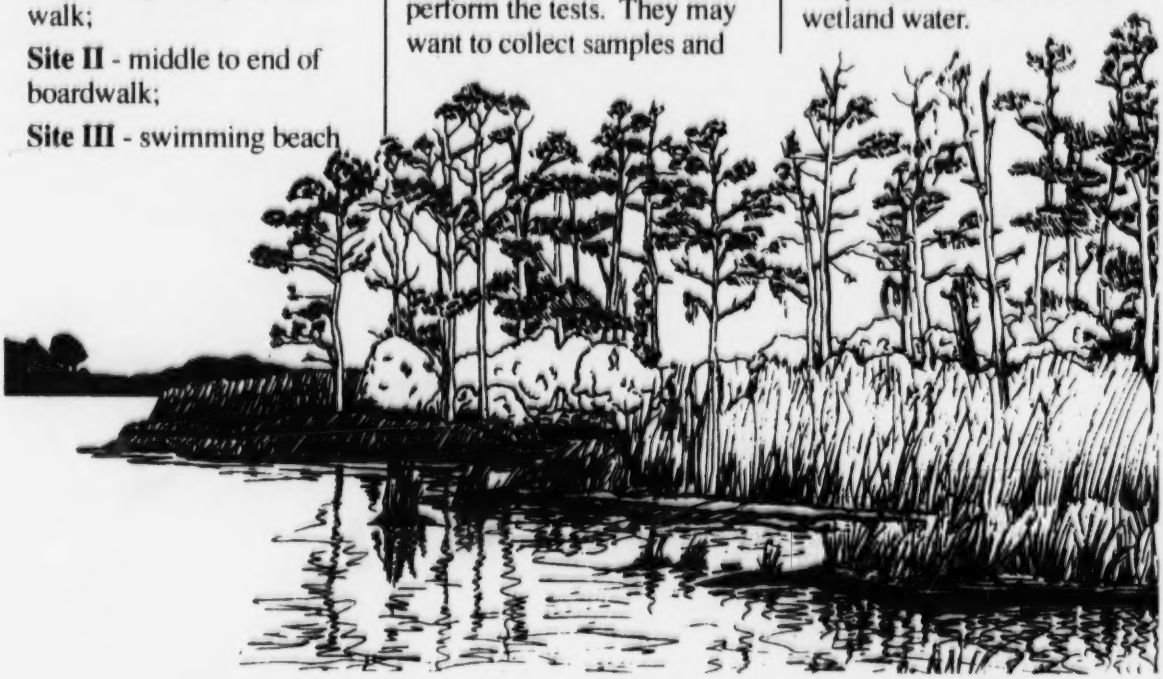
7. Give the students about 45 minutes to collect samples and perform the tests. They may want to collect samples and bring them back to the picnic area to perform the test.

* The students will need to "fix" the DO sample before taking it to the picnic area. This procedure is included in the LaMotte instructions.

8. When the students are finished, gather them in the picnic area to compare and discuss their results.

9. Ask the students to name as many sources of **pollutants that** might affect Goose Creek's wetlands, as they can. Discuss what ways certain pollutants may affect certain **organisms** and how these organisms may be used as **indicator species**.

10. Sum up the activity by emphasizing that wetlands are especially vulnerable to pollution because they may filter and hold pollutants. End the discussion with solutions to the problems associated with wetland water.



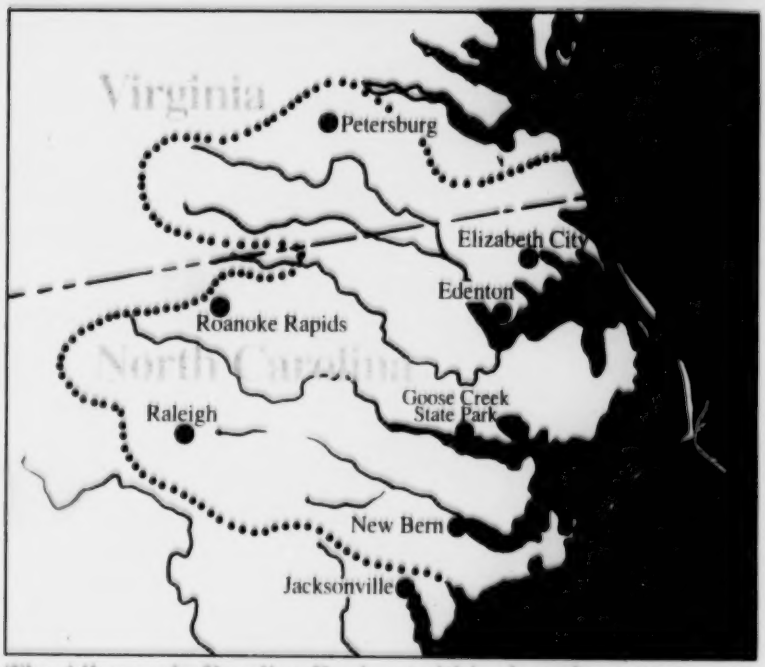
Student's Information

In the Pre-Visit activity, we learned what it takes to make a **wetland**, how wetlands are classified and where some specific types of wetlands are located in North Carolina. This activity will deal with one of the main ingredients of a wetland–**water**.

Goose Creek's wetlands are part of the second largest estuarine system in the United States. This vast region is known as the Albemarle-Pamlico Region and consists of 2.2 million acres of rivers, creeks and sounds. Wetlands are found along the edges of these bodies of water. The Albemarle-Pamlico Region includes the Pamlico and Albemarle sounds, the rivers and streams that empty into them and the **watersheds** that drain these bodies of water. In all, this region includes all or portions of 36 counties in North Carolina and 15 counties in Virginia.

There are 17 watersheds in North Carolina. Goose Creek is located in the Tar-Pamlico watershed.

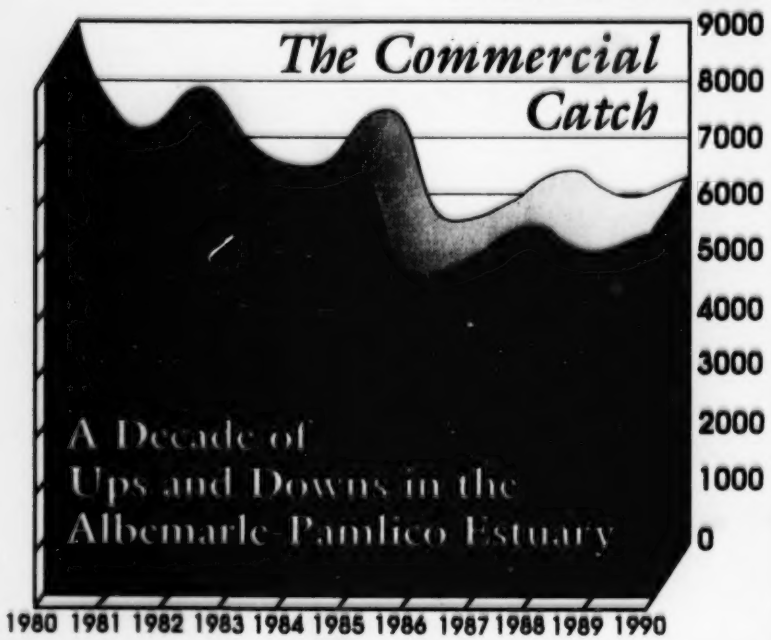
As water passes through these watersheds, it may pick up **pollutants** from many different sources. Recently, wetland ecologists have discovered that one of the more important functions of a wetland is its ability to absorb or filter out pollutants from the water, and in some cases store or recharge groundwater. This is good news; however, wetland eco-logists do not know the long-term effect on wetlands as storage areas for pollutants or how this may affect the animals that utilize wetlands.



The Albemarle-Pamlico Region (within dotted area)

The wetlands at Goose Creek appear to be healthy to the eye, but are they? Pollution in the adjacent Pamlico River has been a major concern in recent years. Major fish kills are not uncommon. Blue crabs in the area frequently suffer from "burnt shell," a disease that causes the shell to erode, and a new **species** of extremely toxic dinoflagellate (a type of **algae**) has appeared which can be deadly to fish and crabs. What has caused this decline in water quality? How will it affect the wetlands and wildlife at Goose Creek? What can we do to detect pollution?

The purpose of this activity is to try to answer these questions by looking at where the water in Goose Creek and the Pamlico River comes from, performing three water quality tests, identifying potential sources of pollution upriver, and discussing how wetlands work as a filter.



Source: N.C. Division of Marine Fisheries

The Tests:

pH:

pH means (p)ower of (H)ydrogen ion activity. Scientists use the **pH scale** to define the degrees of acidity/ alkalinity in soil and water. On one end of the scale, a pH of 0 is extremely acidic (many hydrogen ions, H+), whereas at the other end of the scale, a pH of 14 is extremely alkaline (many hydroxide ions, OH-). A pH of 7 is neutral (equal numbers of H+ and OH- ions), being neither acidic or alkaline.

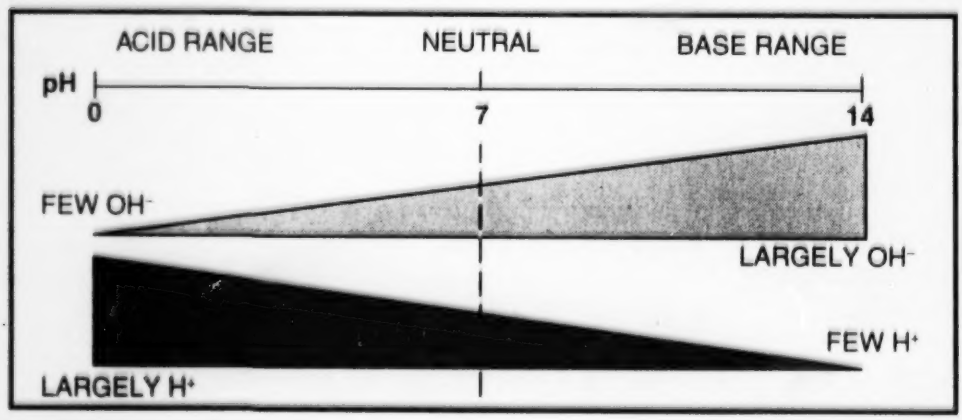
pH is measured on a logarithmic scale with each number representing a factor of ten. Thus, a change in a river's pH from 6 to 5 means that the river is now 10 times more acidic; from 6 to 4 means it is 100 times more acidic.

Different **organisms** tolerate different ranges of pH. In a **pocosin**, soil and water are acidic due to large quantities of **peat** in the soil, which is acidic; therefore, only plants and animals adapted to these conditions can live there successfully. Changes in pH can be caused naturally but drastic changes are usually a result of pollution, like **acid precipitation, sewage effluent** and other chemicals that are washed into our water. By monitoring the pH of our streams and rivers, we can detect extremely high or low pH's that would kill most **aquatic** organisms. Monitoring can alert us to changes in our water quality and help us to protect our waters by giving us clues to the source of the changes.

Salinity:

Salinity is a measure of the amount of salt present in the water. It is expressed in parts per thousand. (ppt). A salinity reading of 6ppt means that there are 6 parts of salt to every 1,000 parts of water.

Salinity is affected by many factors including tidal fluctuations, weather and the amount of freshwater flow. Salt water is heavier than fresh water and higher concentrations of salt may be found at lower depths than at the surface. At



times, the difference in salinity between the surface and bottom is so great that "slugs," or bodies of water with very high salinities, form along or near the bottom. Since these "slugs" of saltwater are near the bottom, there is little **dissolved oxygen** available. If conditions change, for example, high winds mix the "slug" of saltwater with the surrounding water, the sudden mixing of water with little dissolved oxygen available can cause fish kills. Even though natural salinity changes occur daily, a sudden increase or decrease in salinity can be devastating to aquatic species. Remember that salinity changes. It is generally lowest in April and highest in December in the Albemarle-Pamlico region.

Dissolved Oxygen:

Dissolved oxygen - DO: is the amount of oxygen available (dissolved) in the water. It is measured in milligram/liter or parts per million. The amount of DO in water dictates where certain aquatic plants and animals will be found.

Two factors that affect the amount of DO in water are temperature and water movement. Cold water holds more DO than warm water. Moving water increases the surface area where the oxygen mixes with the water. During the day aquatic plants photosynthesize, putting oxygen into the water. At night aquatic plants do not photosynthesize, so DO readings are generally higher during the day and lower at night. Increases in pH due to increases in nitrates or phosphorus, from fertilizers or waste water, may cause excessive plant growth or algae blooms. This sudden increase in aquatic plants can result in extremely low DO at night and can cause massive fish kills.

Wetland Water Data Sheet

Group Name: _____ Date:_____

Temperature: Air _____ Water _____

Location tested: _____

Type of test:_____ Methods used to test:_____

Results

Classroom Samples: Tapwater

pH _____ Salinity _____

Examples of alkaline and acidic liquids

Acidic example - _____

pH _____

Alkaline example - _____

pH _____

Site I Specific Location _____

pH _____ DO _____

Salinity _____ Water temperature_____

Site II Specific Location _____

pH _____ DO _____

Salinity _____ Water temperature _____

Site III Specific Location _____

pH _____ DO _____

Salinity _____ Water temperature _____

Wetland Water Data Sheet Answer Sheet

Group Name: *Goose Creek Waterstriders* Date: *4-5-94*

Temperature: Air *76° F* Water *65° F*

Location tested: *Goose Creek State Park*

Type of test: *pH, DO, salinity* Methods used to test: *LaMotte Water Test Kits*

Results

Classroom Samples: Tapwater

pH _____ Salinity _____

Examples of alkaline and acidic liquids

Acidic example - _____

pH _____

Alkaline example - _____

pH _____

Site I Specific Location *Beginning of Ragged Point Boardwalk*

pH _____ DO _____

Salinity _____ Water temperature _____

Site II Specific Location *Middle of Ragged Point Boardwalk*

pH _____ DO _____

Salinity _____ Water temperature _____

Site III Specific Location *Goose Creek Swim Beach, Pamlico River*

pH _____ DO _____

Salinity _____ Water temperature _____

Curriculum Objectives:

Grade 4

- Communications Skills: listening, reading, vocabulary and viewing comprehension; study skills using environmental sources
- Guidance: evaluate the importance of familiar jobs, competency for interacting with others
- Library/Media Skills: work independently and creatively in preparing assignments
- Science: living things-animals, adaptation to environment, interdependence of animals
- Social Studies: gather organize and analyze information; draw conclusions, use maps, participate effectively in groups

Grade 5

- Communication Skills: listening and visual comprehension, study skills
- Guidance: competency and skill for interaction with others
- Science: Earth science, environment
- Social Science: organize and analyze information, draw conclusions, use maps, participate effectively in groups

Grade 6

- Communication Skills: listening and visual comprehension, study skills
- Guidance: competency and skill for interacting with others
- Healthful Living: environmental health
- Science: ecology
- Social Science: organize and analyze information, draw conclusions, use maps, participate effectively in groups

Location: Classroom

Group Size:
30 students, class size

Estimated Time:
One to three 45-60 minutes

Appropriate Season: Any

Credits:
Adapted from "Dragonfly Pond" *Aquatic Project Wild,* Western Regional Environmental Education Council

Materials:
Provided by educator:
Per student: one copy of Student's Information, and "Special Species Fact Sheet"
For each three students: scissors, masking tape, paste or glue, paper, one copy of each of: "Legend and Land Use Cut-outs," Topo Map of Goose Creek Area," "Pamlico River to Pamlico Sound"

Major Concepts:

- Human impact on Goose Creek wetlands and the Pamlico River
- Water quality
- Land use planning and its effect on Goose Creek and areas down river
- Resource management

Objectives:

- Evaluate the effects of different imaginary land uses on Goose Creek and the Pamlico River.
- Discuss and list five ways to minimize damaging effects on Goose Creek and the Pamlico River.

Educator's Information:

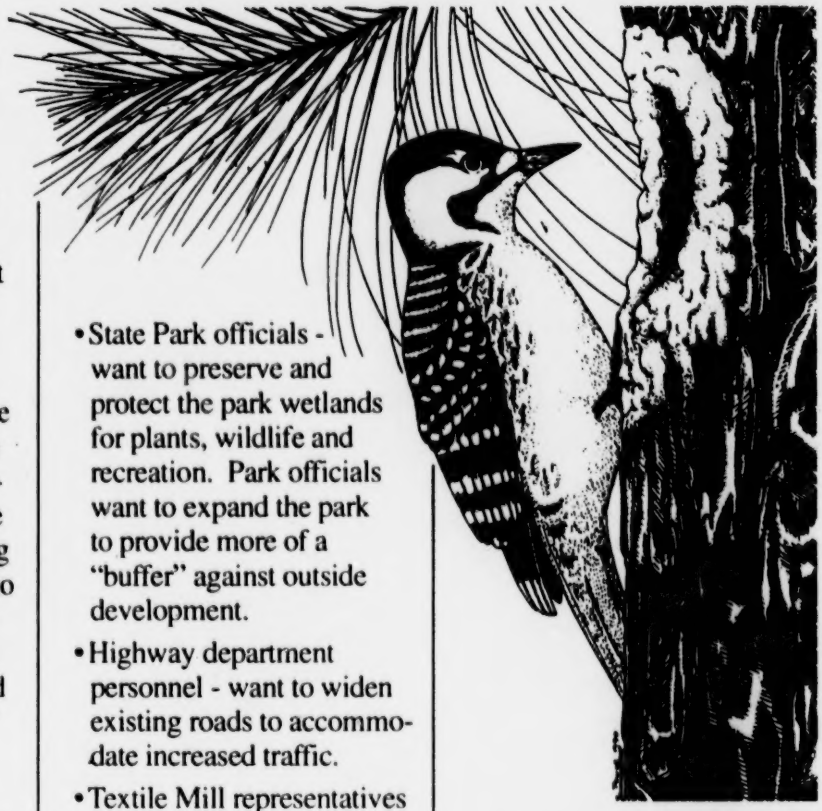
The purpose of this activity is to encourage students to wrestle with development, economic and resource management issues. The students will use the Goose Creek area as a **microcosm** of **environmental** concerns in making management decisions. They will contend with the arrangement of overlapping and conflicting land uses in an effort to preserve the Goose Creek area. When the students reach some kind of agreement about local issues, they will discuss how their actions affect the river downstream. The activity ends with the idea that the planet Earth is, in fact, a single Goose Creek.

Instructions:

1. Prepare copies of the land use cutout sheets, the "Topo Map of Goose Creek" the Student's Information and "Special Species Fact Sheet" ahead of time. Explain the activity. Tell the students that they will be responsible for arranging the pattern of land use around Goose Creek in such a way as to minimize the impact on Goose Creek State Park and their **wetlands**. Remind them that some of these land uses might be conflicting and therefore they will have to make some very tough management decisions. Pass out the Student's Information and "Special Species Fact Sheet" and have the students read them.

2. Divide the class into groups of three to five, with each group representing one of the interest groups. Students will stay in these groups until the end of the activity. Possible interest groups are:

- Residents - want to live in the area.
- Farmers - want to use the land to raise food and livestock.
- Tree farmers - want to clear land and drain wetlands to plant pine trees to provide lumber and provide pulpwood for paper.
- Developers - want to build marinas, condominiums and expensive homes near the **water**. This would create jobs and help the local economy.



- State Park officials - want to preserve and protect the park wetlands for plants, wildlife and recreation. Park officials want to expand the park to provide more of a "buffer" against outside development.
- Highway department personnel - want to widen existing roads to accommodate increased traffic.
- Textile Mill representatives - want to build a new plant to provide jobs.
- County and State representatives - are looking for a new landfill and **waste water treatment plant** site.

3. Pass out the "Topo Map of Goose Creek." Read aloud, or have the students read, the following information:

You will be using an enlargement of an actual **topographic** map of Goose Creek State Park and surrounding area. Topographic is derived from Greek words *topos*, meaning place, and *graphein*, meaning to write or draw. Thus, a topographic (topo) map is a drawing or picture of a place. One feature on a topo map is contour lines. Contour lines are thin lines that indicate the contour, or shape, of the land and its elevation. Where the lines are very close together there is steep terrain. Level terrain appears where contour lines are further apart. A legend explaining other map symbols is included on the "Legend and Land Use Cutouts" page.

Spend some time discussing features and symbols on the topo map. Practice locating rivers, highways, contour lines, etc. Then read the following text aloud:

Notice that there are four **species** of animals and one species of plant on the map where they might naturally occur. These species are either state protected or have

special **habitat** requirements. The purpose of placing these on the topo is to make the decisions more realistic. Information on these species is on the "Special Species Fact Sheet."

4. Pass out the "Land Use Cutouts" sheet and the "Topo Map." Have the students cut out the land use pieces. When they fasten the cutouts to their "Topo Map," suggest that they use small loops of tape. This will allow them to change their minds before they paste them down.

5. Place the following rules on the chalkboard:

- All land use cutouts must be used; the cutouts may be cut smaller.
- Cutouts may touch, but may not overlap.
- No cutout, except for the state park, can touch or cover a "Special Species" circle.
- Except for the state park, pine plantation and vegetable farm, all cutouts must touch a new or existing road.
- The marina, waste water treatment plant, and textile mill must touch water.
- No cutout can touch or cover an existing building.

6. Once the students have cut out the necessary materials and are ready to begin the process of making land use decisions, have them create a list of pros and cons for each land use. Guide the class discussion so that they consider the consequences of each land use. Record these on the chalkboard.

7. Have the students work in their teams for a long enough period of time to begin to seriously grapple with the challenge.

8. Invite each group to volunteer to display and describe their work in progress. Encourage discussion of their choices. In the discussions emphasize that:

- no land use can be excluded;
- wildlife habitat must be preserved;
- everyone must agree.

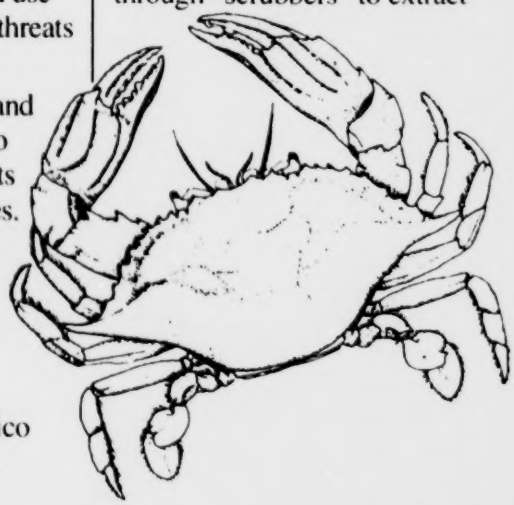
Look for the consequences of their proposed land use plans. Be firm about the issues, but fair about this being a very difficult set of choices. Ask additional groups to volunteer to show their work in progress and discuss their similarities. Remind them that for certain habitats this may be a "no-win" activity in many ways. The best that can be hoped for is that the land use plans will minimize the threats to Goose Creek.

9. Display all the final land use plans for everyone to see and discuss the merits of each of the approaches. Point out that although their solutions may not be perfect, they can minimize the damage to Goose Creek.

10. Pass out the " Pamlico River to the Pamlico Sound" sheet. Choose one group's land use plans and connect their topo to the "Pamlico River to the Pamlico Sound."

11. Ask the students to brainstorm possible effects that their land use plans could have on the water quality, wetlands and people downstream. The **effluent** from the textile mill can be used as an example. How will it be treated? Where? By whom? Where will it go? What effect will it have on water quality, wetlands, wildlife and people?

12. Ask the students to look again at all of the land uses in this activity. If they considered any of them as inherently bad, have them consider a different question. What could the people who are actually in charge of these various land uses do in their practice to minimize the damage to Goose Creek. Have the activity end with an emphasis on solutions rather than on problems. Point out, for example, the revolution tak-ing place in the "mining" of industrial effluent through "scrubbers" to extract



wastes as profitable resources. (Perhaps the students need to make a "scrubbing filter" for the textile mill). Agricultural practices are changing so as to reduce the use of potentially lethal agents. Petroleum wastes are being recycled and domestic awareness about the uses of pesticides and detergents is increasing.

13. Could the wetland be used as a filter for the livestock yard or **sewage** plant? Perhaps another wetland could be created just to handle discharges from one of these areas.

14. Ask the students to create a list of things they think they personally can do to begin to reduce the potentially damaging effects of their own lifestyles on "downstream" habitats. If possible, invite them to periodically, throughout the school year, report on their progress in carrying out these new practices. Discuss with them the concept that all the wetlands of the planet are, in fact, part of a single "Goose Creek."

Extensions:

1. Set up an action team to locate wetlands in your community. Determine the overall quality of the wetlands.

2. Using a North Carolina road map, trace the Pamlico River upriver from Goose Creek State Park to the Tar River. Trace the Tar River upriver as far as you can. List all the sites that you can identify that might lower the quality of the waters.

3. Collect newspaper articles on local water-related and land use issues as a current events activity.

4. Learn more about environmental impact statements. Try to obtain actual copies of statements about wetlands in your area. See what concerns are addressed in these documents.

5. Learn about the national wildlife refuge system. Are there any wildlife refuges in your area? What animals find refuge in them? Visit a national wildlife refuge.

6. Find out about private organizations that work to protect wetlands. Two examples are The Nature Conservancy and Ducks Unlimited. Perhaps you could ask for someone from one of these organizations to come speak to your class.

7. Find out about zoning laws and land use regulations in your area. Would the plan you proposed in this activity be allowed in your community?

8. Send a representative sample of the students' land use plans to the park. (We would appreciate the feedback.)

Student's Information

Every human use of land in the Goose Creek area affects wildlife **habitat**, positively or negatively. What humans do with land is a reflection of human priorities and lifestyles. The search for a modern day "good life" and all of its conveniences produces mixed results for **wetlands, water** quality and wildlife in the Goose Creek area. Sometimes people see undeveloped areas of natural **environment** as little more than raw material for human use. Others believe that the natural environment is to be preserved without regard for human needs. Still others yearn for a balance between economic growth and a healthy and vigorous natural environment. Very real differences of opinion regarding this balance exist between well-meaning people.

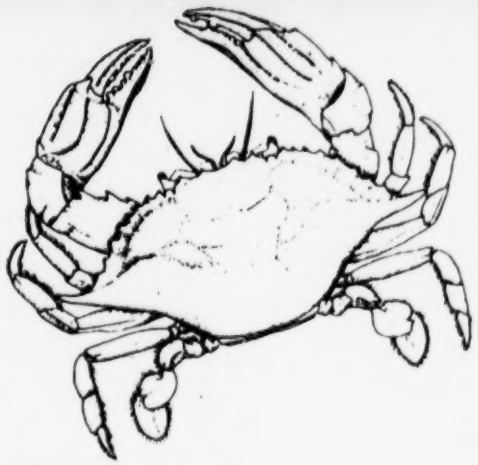
At the core of land use issues is the concept of growth. Growth in natural systems has inherent limits, imposed by a dynamic balance of energy between all parts of the system. Energy in natural systems is translated into food, water, shelter, space and continued survival. This means that the vitality of natural systems is expressed by their ability to be self-regulating. This capacity for self-regulation makes it possible for all natural members of an **ecosystem** to live in harmony. All the life forms of any ecosystem must be considered. The microbes in the soil are just as necessary to a habitat as the plants and predators. It is this natural dynamic balance, with all its inherent and essential parts, that much of human land use has tended to disturb.

Human activities can often go beyond the natural limits of a setting. Humans have the ability to import energy sources that allow a system to exceed its natural limits–or to remove energy sources that are necessary for a system to stay in balance. For example, people can build dams to create power, water can be captured for irrigation and wetlands can be drained for homes and buildings. All of these activities affect wildlife habitat.

Wetlands, for example, are often seen as swampy wastelands, yet they are the nurseries for hundreds of forms of wildlife. Fish, frogs, toads, migrating birds, snakes, insects and a remarkable variety of plants all make a home in wetlands. Wetlands are, however, highly vulnerable to development, **pollution** and a variety of forms of human interference with the natural flow of water. Hundreds of thousands of acres of valuable wetlands are lost each year to draining, dredging, filling and pollution.

Given the extensive impact humans have already had and continue to have on wetlands, a major challenge now facing humans is how to have a more responsible impact. How can we develop the awareness, knowledge, skills and commitment that are necessary in order for humans to take responsible actions toward the remaining areas of natural wetland habitat? How can we develop the necessary understanding to restore a more natural dynamic balance in places where human disturbance has existed for centuries?

Special Species Fact Sheet

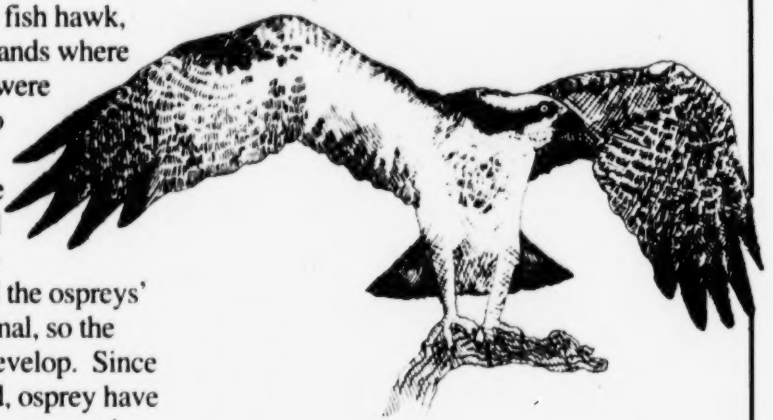


Blue Crab

This tasty crustacean is one of the most economically important species in North Carolina. From 1970 to 1978, 10 million pounds were harvested from Pamlico Sound. They occur from the salty waters of our sounds to the freshwater marshes at Goose Creek. In recent years, blue crabs have suffered from a bacteria that eats a hole through their shell. The bacteria appears to be associated with polluted water. Blue crab harvests have declined due to this bacteria.

Osprey

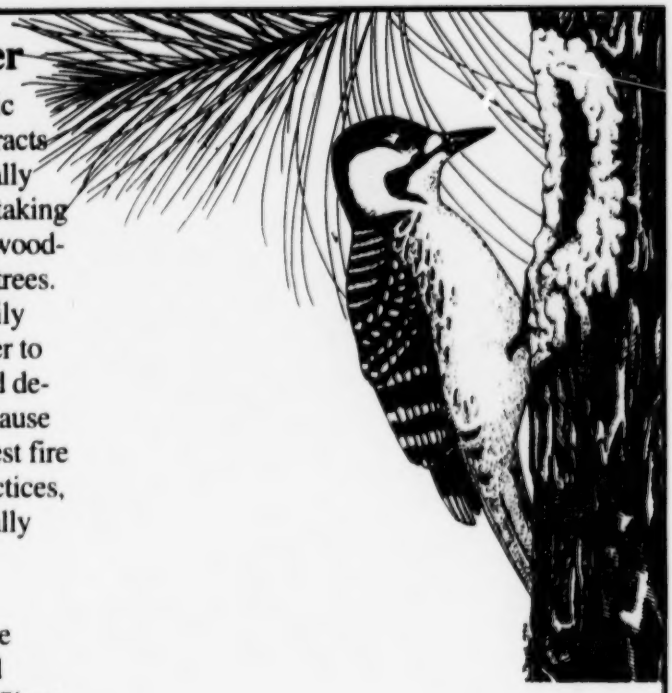
Also known as fish eagle and fish hawk, osprey often nest in or near wetlands where they feed mainly on fish. They were once a threatened species, due to pesticides like DDT that were used on crops. DDT got into the food chain, and osprey absorbed this pesticide by eating contaminated fish. The pesticide caused the ospreys' eggshells to be thinner than normal, so the eggs would often break or not develop. Since the use of DDT has been banned, osprey have made a comeback and have been removed from the threatened species list in North Carolina.



American Bittern

A large heron like bird that lives exclusively in marsh wetlands, the bittern feeds on frogs, fish, snakes, salamanders, mice and other such small animals which they catch with their long dagger-like beak. Bitterns are camouflaged to blend in with marsh grasses, so they are seldom seen. If a bittern senses that it has been seen it will "freeze" with its bill pointing straight up, and stretch to appear thin like the marsh grasses surrounding it. This behavior gave rise to the common names sky-gazer, look-up and sun-gazer. American bitterns numbers have declined in North Carolina due to habitat loss.

*Red-cockaded Woodpecker



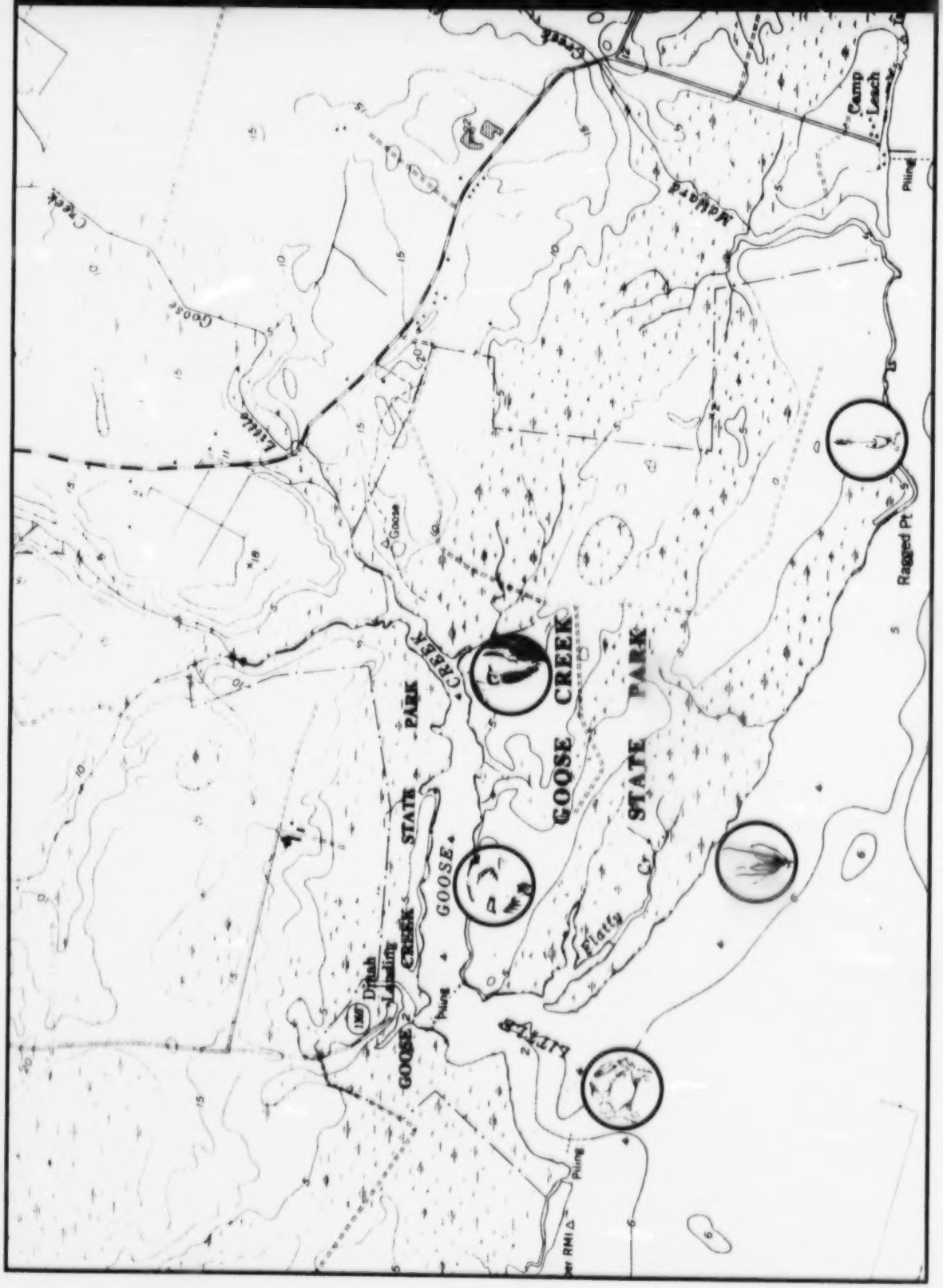
These woodpeckers have very specific habitat requirements. They need large tracts of southern pine forest that are periodically burned to prevent hardwood trees from taking over. Unlike most woodpeckers, these woodpeckers excavate cavities in living pine trees. Red-cockaded woodpeckers live in family groups called clans. Clans work together to excavate cavities, care for the young and defend their territory, called a colony. Because of the specific habitat requirements, forest fire suppression and changes in forestry practices, red-cockaded woodpeckers are a Federally Endangered Species.

*While not a wetland species, red-cockaded woodpeckers are present in the park. Park staff have initiated prescribed burns in order to improve their habitat. Since the red-cockaded woodpecker receives full protection under the Federal Endangered Species Act, we include it to make the students land use decisions more complicated.

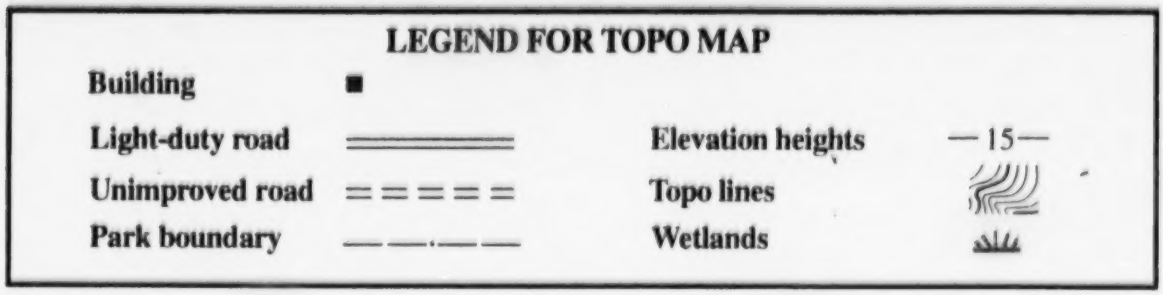
Wild celery

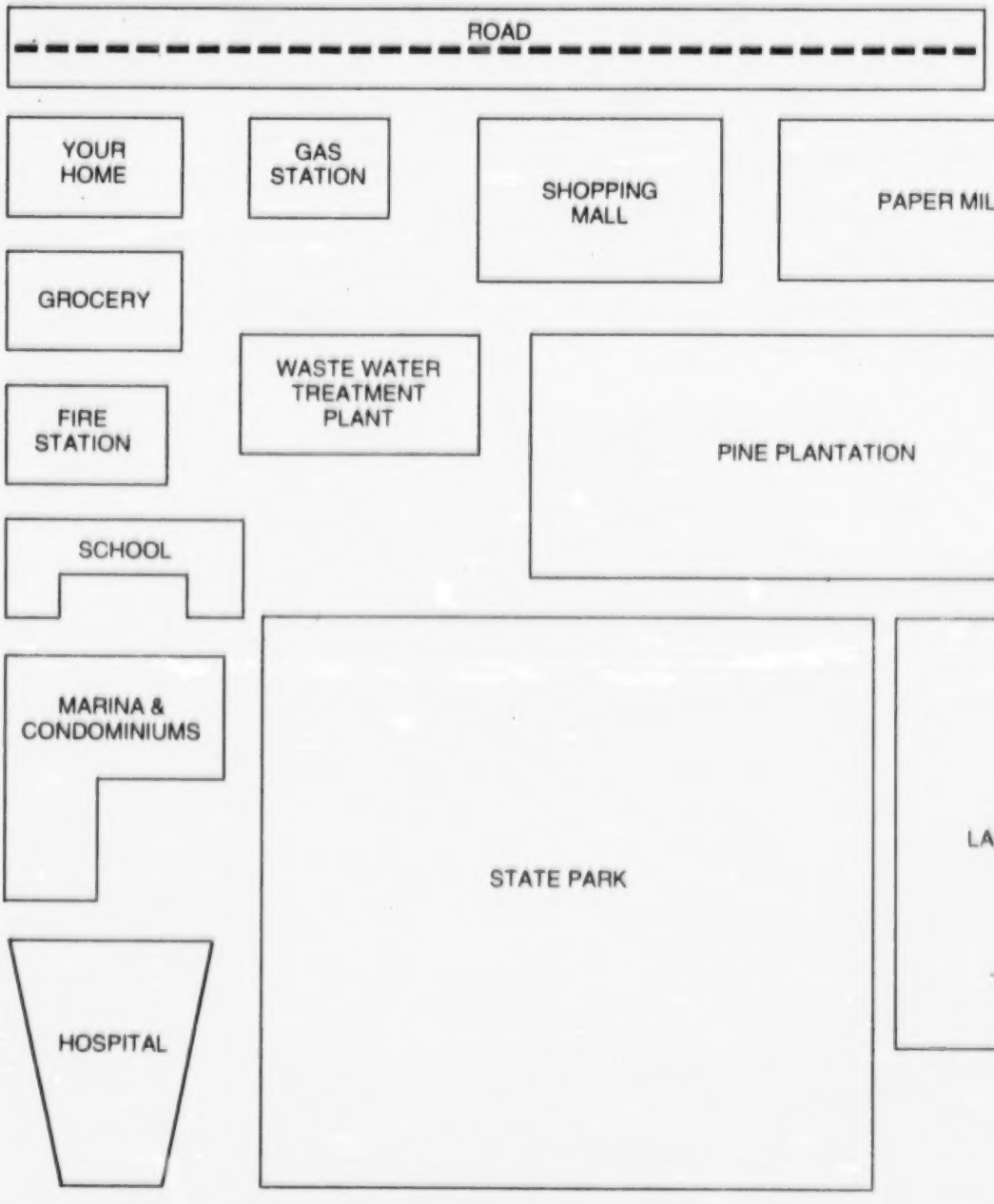
Wild celery is a submerged aquatic plant with long ribbon-like leaves, each with a light-colored central stripe. Wild celery is tolerant of muddy, turbulent waters. It can be found in salinities from 0 to 13 ppt, but prefers fresh to brackish water. Wild celery plants are not as abundant in the Pamlico River as they are in other parts of the Pamlico-Albemarle region, possibly due to lowered water quality in the Pamlico River. Wild celery is an important waterfowl food and the thick stands of wild celery provide cover and habitat for fish, crabs, shrimp and other aquatic creatures.

Topo Map of Goose Creek Area



Legend and Land Use Cutouts





Pamlico River To The Pamlico Sound

Goose Creek State Park, NC

5.1.10

August 1994

VOCABULARY

Acid - Having a pH less than 7; the chemical state of water or other substance in which the hydrogen (H+) ions exceed the hydroxyl (OH) ions. For example, a car's battery acid has a pH of 1. See pH scale.

Adaptation - A change in the structure or activity of an organism that produces a better adjustment to its environment, thus enhancing its ability to survive and reproduce.

Aerenchyma - Air spaces in roots and stems that allow the diffusion of oxygen from the aerial portions of the plant into the roots. Wetland soils have little oxygen available. Aerenchyma transport oxygen from their leaves and stems down to their roots.

Algae - Primitive one-celled or multi-cellular plants that contain chlorophyll, but has no true root, stem or leaf. Normally found in water or damp places.

Alkaline - Having a pH greater than 7; the chemical state of water or other substance in which the hydroxyl (OH-) ions exceed the hydrogen (H+) ions. For example, soap has a pH of 10. See pH scale.

Anaerobic - A lack of oxygen, in reference to soil. Anaerobic soils are usually water logged or saturated with water. Anaerobic soils prevail in wetlands.

Aquatic - Growing, living in or frequenting water.

Bacteria - Any of the numerous unicellular microorganisms of the class Schizomycetes, occurring in a wide variety of forms, existing either as free-living organisms or as parasites. Bacteria have a wide range of biochemical and often pathogenic properties. Bacteria are very important in decomposition.

Blackwater - A term used to describe the water in certain coastal plain rivers and streams. Blackwater streams tend to be acidic, low in mineral sediment and nutrients. The water is colored by tannins but appears fairly clear in shallow areas. In deeper areas, the water appears black.

Brackish - Water having a salt content between fresh water and sea water.

Buttress - The swollen base of frequently flooded trees. It provides trees located in moist, soft soil with more stability. Water tupelo trees have buttresses.

Classification - The grouping of organisms into categories based on shared characteristics or traits. For example, any animal that has feathers is considered a bird and placed in the Class Aves. Furthermore, if the bird has its eyes in front rather than on the side of its head, it is a member of the Order Strigiformes (the owls).

Community - A group of plants and animals living in a specific region under similar conditions, and interacting with each other through food webs and other relationships.

Dichotomous - Divided into two parts, groups or classes, such as a dichotomous key. Using a dichotomous key, one can identify an unknown organism by following the one branch of each pair that best describes the organism.

Dissolved Oxygen (DO) - The amount of oxygen gas molecules dissolved in water. Fish and other aquatic animals depend on DO for respiration.

Ecosystem - Plants, animals, their physical surroundings and their interactions with each other.

Effluent - A liquid which flows out. The outflow of a sewer, septic tank, etc.

Endangered Species - A species that verges on extinction in all or part of its range.

Environment - The surroundings of an organism, including plants and animals.

Fen - An old English word used to describe a wetland. Some scientists use fen to describe a specific type of wetland that has mineral rich waters seeping into them. The water in fens is usually higher in pH, (basic). In contrast, bogs have low pH, (acidic).

Habitat - Place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristics.

Hydric - Term used to describe soil that is saturated for long enough periods to develop anaerobic conditions which favor the growth of hydrophytic plants (water loving plants).

Hydrophytic - Plants that have adapted to living in hydric soils and anaerobic conditions.

Indicator Species - An organism whose presence or absence in a particular environment can be used to determine the health of that particular environment.

Key - An ordered list of significant characteristics of a group of organisms used to identify unknown species.

Microcosm - "Little world," a community or other unity that is an example of a larger unit.

Organic - Of, relating to, or derived from living organisms.

Organism - A living thing; a form of life composed of mutually dependent parts that maintain various vital processes.

Pheumatophors - Aerial roots or secondary roots that stick above the water. They may help exchange gases (i.e. oxygen etc).

Peat - Partially carbonized vegetable tissue formed by partial decomposition of various plants in water.

pH - The power of the hydrogen ion (H+) activity in a substance.

pH Scale - A range of 0 to 14, used to measure the degree of acidity or alkalinity of a substance. A pH of 7 is neutral.

Pocosin - An upland swamp of the coastal plain of the southeastern U.S.

Pollutants - Something that pollutes, makes physically impure or unclean.

Precipitation - A deposit on the earth of hail, mist, rain, sleet or snow.

Salinity - A measurement of the amount of dissolved salt, often stated in parts per thousand (ppt). Ocean water usually averages about 35 ppt, while estuarine waters vary greatly in salinity between 0 and 35 ppt.

Sediment - Particles of mud, sand, clay, silt and organic material carried in water that settle to the bottom or which compose the bottom material (substrate) on which a plant or animal lives.

Sewage - Liquid and solid waste mixed with water.

Species - A biological classification of organisms. All organisms of a single, distinct kind that have a high degree of similarity, and can mate and produce fertile offspring.

Threatened Species - A species that could become endangered in the future if it is not given some kind of protection.

Tide - The periodic variation in the surface level of the oceans and bays, gulfs, inlets and tidal regions of rivers, caused by the gravitational attraction of the sun and moon or the movement of the water by wind.

Topographic - From the Greek words *topos*, meaning place and *graphein*, meaning to write or draw; a detailed map showing topography of the land.

Waste Water Treatment Plant - A facility where household, business and industrial sewage are treated to remove harmful bacteria and chemicals.

Water - A colorless, transparent liquid occurring on the earth's surface as rivers, lakes, oceans, etc. A chemical compound of hydrogen and oxygen, H_2O.

Watershed - The total land area that drains directly or indirectly into a particular stream, river or lake.

Wetland - An area flooded by water frequently enough to support plants adapted to living in regularly or seasonally wet soil. Examples of wetlands are swamp forests, marshes, bogs, pocosins and Carolina bays.

References

Angier, Bradford. (1978) 1981. *Field Guide to Medicinal Wild Plants.* Reprint. Harrisburg, PA: Stackpole Books.

Brockman, C. Frank and Rebecca Merrilees. 1968. *Trees of North America, A Golden Field Guide.* Racine, Wisconsin: Western Publishing Company, Inc.

Burt, William Henry and Richard Phillip Grossenheider. (1952) 1964. *A Field Guide to the Mammals,* The Peterson Field Guide Series. Reprint. Boston: Houghton Mifflin Company.

Conant, Roger. 1975. *A Field Guide to Reptiles and Amphibians of Eastern and Central North America.* 2nd edition, The Peterson Field Guide Series. Boston, MA: Houghton Mifflin Co.

Everhart, Jerry (project director). 1986. *Project MOST.* For more information, contact Pitt County Schools, 1717 West 5th St., Greenville, NC 27834.

Finlayson, Max and Michael Moser. 1991. *Wetlands.* Oxford, U.K.: Facts on File.

Gale, A. Judith. 1989. *A Guide to Estuaries of the Albemarle-Pamlico Region North Carolina.* For more information, contact the Albemarle-Pamlico Estuarine Study, Division of Water Resources, 512 North Salisbury Street, Raleigh, NC 27604-1148.

Hoveland, Jane. *Wetlands.* For more information contact the Camp Lejeune Dependents' Schools, Camp Lejeune, NC 28542.

Lippson, Alice J. and Robert L. Lippson. 1984. *Life in the Chesapeake Bay.* Baltimore: John Hopkins University Press.

Mitchell, Mark and William Stapp. 1990. *Field Manual for Water Quality Monitoring. An Environmental Education Program for Schools.* Dexter, MI: Thomson-Shore Printers.

Mitsch, J. William, and James G. Gosselink. 1986. *Wetlands.* New York, NY: Van Nostrand Reinhold.

National Wildlife Federation. 1987. *Status Report on Our Nation's Wetlands.* For more information, contact the National Wildlife Federation, 1400 16th St., N.W., Washington, DC 20036-2266.

National Wildlife Federation. 1989. "Wading into Wetlands," *Ranger Rick's Nature Scope.* . For more information, contact the National Wildlife Federation, 1400 16th St., N.W., Washington, DC 20036-2266.

North Carolina Agricultural Research Service. 1984. *Soil System in North Carolina,* Bulletin 467. For more information, contact the North Carolina State University, Raleigh, NC 27695.

Penak, W. Robert. 1989. *Freshwater Invertebrates of The U.S.* New York, NY: The Ronald Press Co.

Peterson, Charles H., John Wells. 1986. *Restless Ribbons of Sand, Atlantic and Gulf Coastal Barriers.* For more information, contact Institute of Marine Sciences. UNC-Chapel Hill, Morehead City, NC 28557.

Peterson, Lee Allen. 1977. *A Field Guide to Edible Wild Plants.* Boston: Houghton Mifflin Company.

Reid, K. George and Herbert Zim. 1967. *Pond Life, A Golden Guide.* Racine, WI: Western Publishing Company, Inc.

Robbins, Chandler S., Bertel Bruun and Herbert S. Zim. 1983. *Birds of North America, A Golden Field Guide.* Racine, WI: Western Publishing Company, Inc.

Schafale, Michael P., Alan S. Weakley. 1990. *Classification of the Natural Communities of North Carolina -- Third Approximation.* For more information, contact the North Carolina Natural Heritage Program, Division of Parks and Recreation, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Slattery, Britt E. 1991. "Wet'n'Wild" activity. *WOW!: The Wonders of Wetlands: An Educator's Guide.* For more information, contact Environmental Concern, Inc., P.O. Box P, St. Michaels, MD 21663.

Smith, Gibbs M. ed. 1980. *Natural History Essays.* Magnolia MA: Peter Smith Publishers, Inc.

Western Regional Environmental Education Council. 1987. *Aquatic Project WILD.* For more information, contact the Wildlife Resources Commission, 512 North Salisbury St., Raleigh, NC 27604-1148.

Western Regional Environmental Education Council. 1985. *Elementary Project WILD.* For information, contact the North Carolina Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1148.

Western Regional Environmental Education Council. 1986. *Secondary Project WILD.* For information, contact the North Carolina Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1148.

Zim, Herbert S. and Hobart M. Smith. (1953, 1956) 1987. *Reptiles and Amphibians, A Golden Guide.* Reprint. Racine, WI: Western Publishing Company, Inc.

SCHEDULING WORKSHEET

For office use only:
Date request received_____ Request received by_____

1) Name of group (school) _____

2) Contact person _____ _____
name phone (work) (home)

_____
address

3) Day/date/time of requested program _____

4) Program desired and program length _____

5) Meeting place _____

6) Time of arrival at park _____ Time of departure from park _____

7) Number of students _____ Age range (grade) _____
(Note: A maximum of 30 participants is recommended.)

8) Number of chaperones _____
(Note: One adult for every 10 students is recommended.)

9) Areas of special emphasis _____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations)_____
_____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: _____
_____

12) Are parental permission forms required? _____ If yes, please use the Parental Permission form on page 8.2.

I, _____, have read the entire Environmental Education Learning Experience and understand and agree to all the conditions within it.

Return to: Goose Creek State Park
Route 2, Box 372
Washington, NC 27889

Fax: (919) 923-0052

PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at **Goose Creek State Park**. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name _____

Does your child:

- Have an allergy to bee stings or insect bites?_____
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? _____ _____

- Have any other health problems we should be aware of?_____
  _____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

_____ _____
Parent's signature date

Parent's name _____ Home phone _____
(please print) Work phone _____

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) _____ Date _____
   Program leader(s) _____

2. What part of the program(s) did you find the most interesting and useful? _____
   _____

3. What part(s) did you find the least interesting and useful? _____
   _____

4. What can we do to improve the program(s)? _____
   _____
   _____

5. General comments _____
   _____
   _____
   _____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS
PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

6. Group (school) name _____

7. Did the program(s) meet the stated objectives or curriculum needs? _____
   If not, why? _____
   _____

Please return the completed form to park staff. Thank you.

Goose Creek State Park
Route 2, Box 372
Washington, NC 27889
Fax: (919) 923-0052